United States Patent [19]

Holyoke

[11] **Patent Number: 5,046,286**

[45] **Date of Patent: * Sep. 10, 1991**

[54] **APPARATUS AND METHOD FOR REMOVING PHOTOGRAPHIC IMAGES FROM A FLEXIBLE FILM MEMBER**

[76] Inventor: **Robert H. Holyoke,** 4001 N. Ocean Blvd., Apt. 301B, Boca Raton, Fla. 33431

[*] Notice: The portion of the term of this patent subsequent to Jul. 17, 2007 has been disclaimed.

[21] Appl. No.: **511,305**

[22] Filed: **Apr. 19, 1990**

[51] **Int. Cl.**[5] **B24B 21/00**

[52] **U.S. Cl.** .... **51/137;** 51/74 R; 51/78; 51/326

[58] **Field of Search** .... 51/74 R, 78, 137, 138, 51/139, 326

[56] **References Cited**

U.S. PATENT DOCUMENTS

1,022,827	4/1912	Cox	51/139
2,424,044	7/1947	Miller	51/139
3,153,306	10/1964	Robischung	51/135
3,277,609	10/1966	Horie et al.	51/78
3,683,559	8/1972	Kalwaites	51/74
4,201,015	5/1980	Reim	51/74

Primary Examiner—M. Rachuba

Attorney, Agent, or Firm—Oltman and Flynn

[57] **ABSTRACT**

This apparatus and method for removing photographic images from a flexible Mylar film member is based on scraping laterally spaced areas of the film member passing between respective power-driven film-advance rollers and spring-biased pressure rollers. The film member is scraped by power-driven, endless, flexible, abrasive belts passing next to the film-advance and pressure rollers but out of contact with them. Each abrasive belt is tensioned to follow part of the peripheral contour of a belt-deflection roller located next to a film-advance roller. The speed of the abrasive belts is many times greater than the surface speed of the film-advance rollers. Two laterally offset sets of film-advance rollers and abrasive belts engage the film member at different locations along its path of movement, and the last set of abrasive belts scrape segments of the film member that were not scraped by the first set of belts.

23 Claims, 7 Drawing Sheets

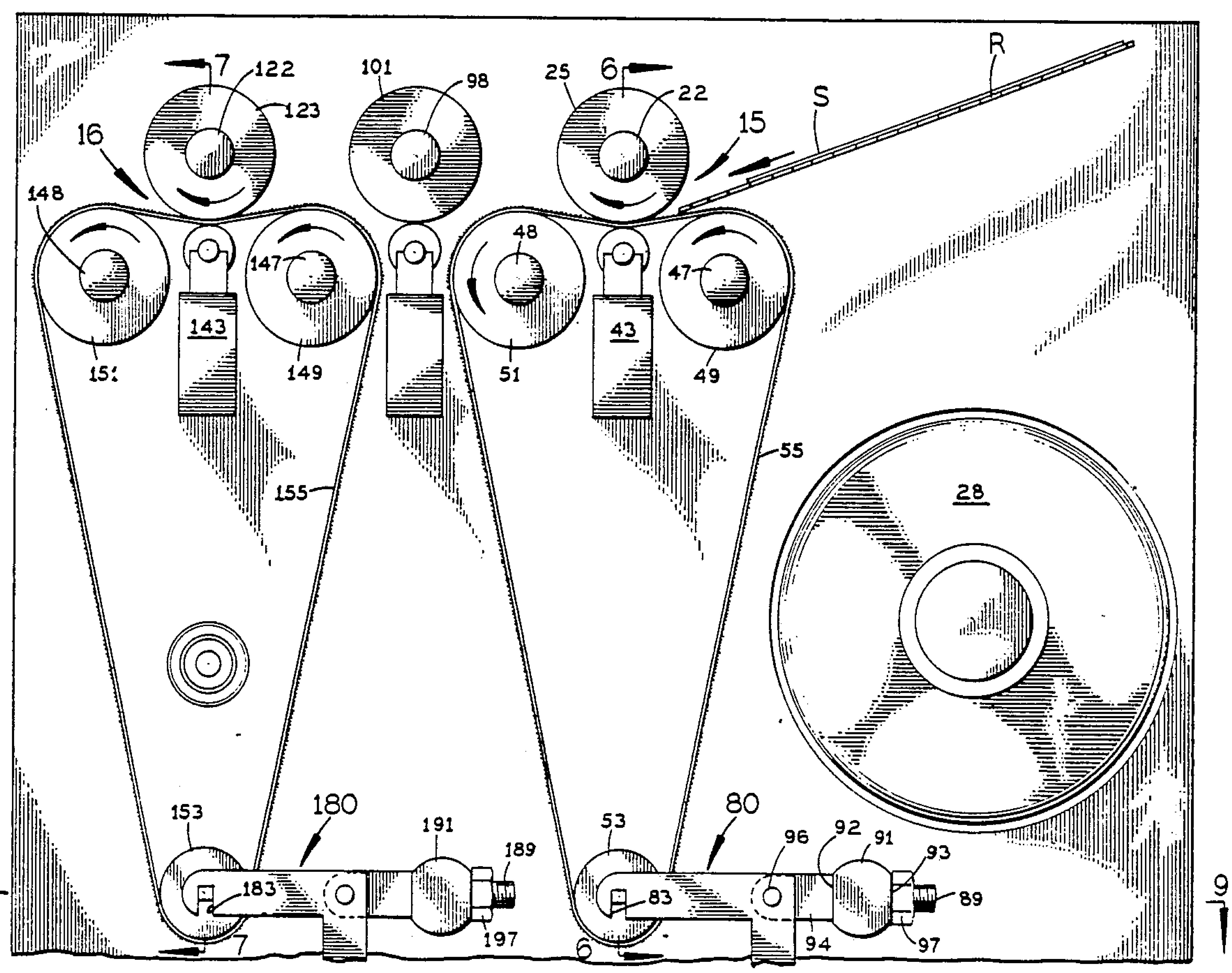
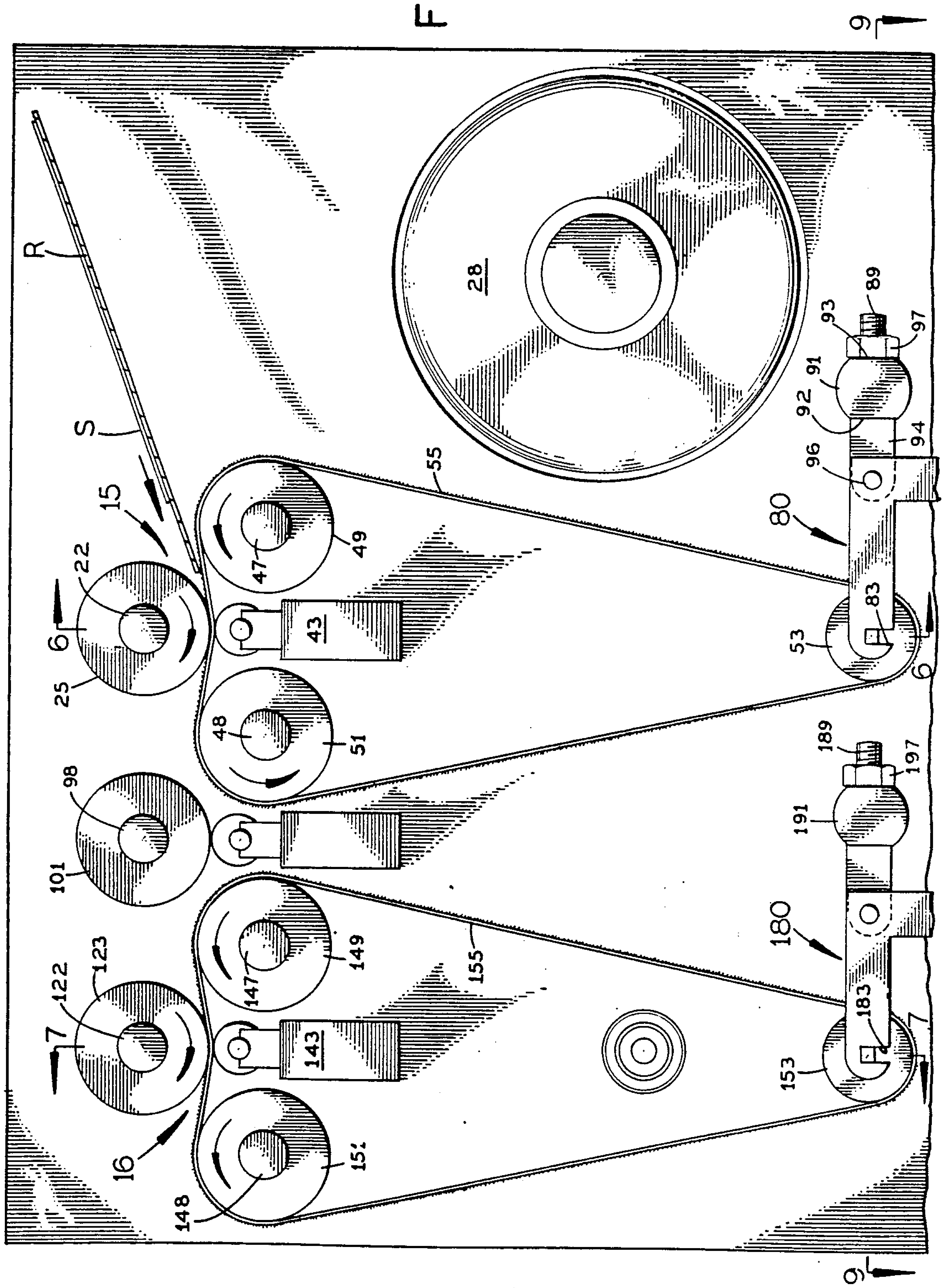


FIG. 1



R
S
15
22
6
25
28
55
47
49
43
53
83
80
96
94
92
91
93
89
97
48
51
98
101
189
197
191
180
149
147
155
123
122
7
143
153
183
16
148
15
9

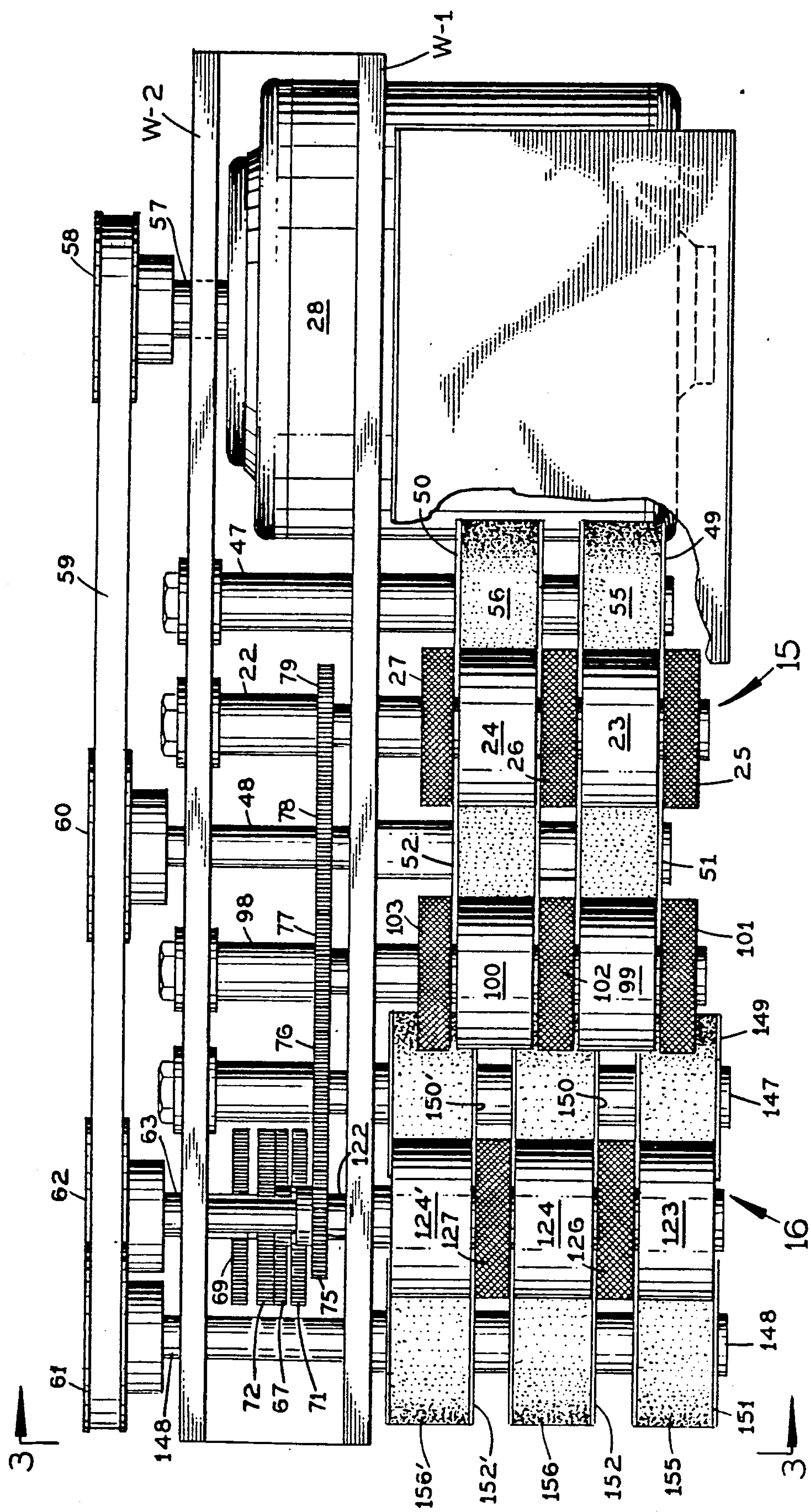

W-1
W-2
58
57
28
59
60
62
63
61
148
47
22
48
98
79
78
77
76
122
69
72
67
71
75
27
52
103
50
49
56
55
24
26
23
25
51
100
102
99
101
149
150'
150
147
124'
127
124
126
123
156'
152'
156
152
155
151
15
16
3
3

FIG. 2

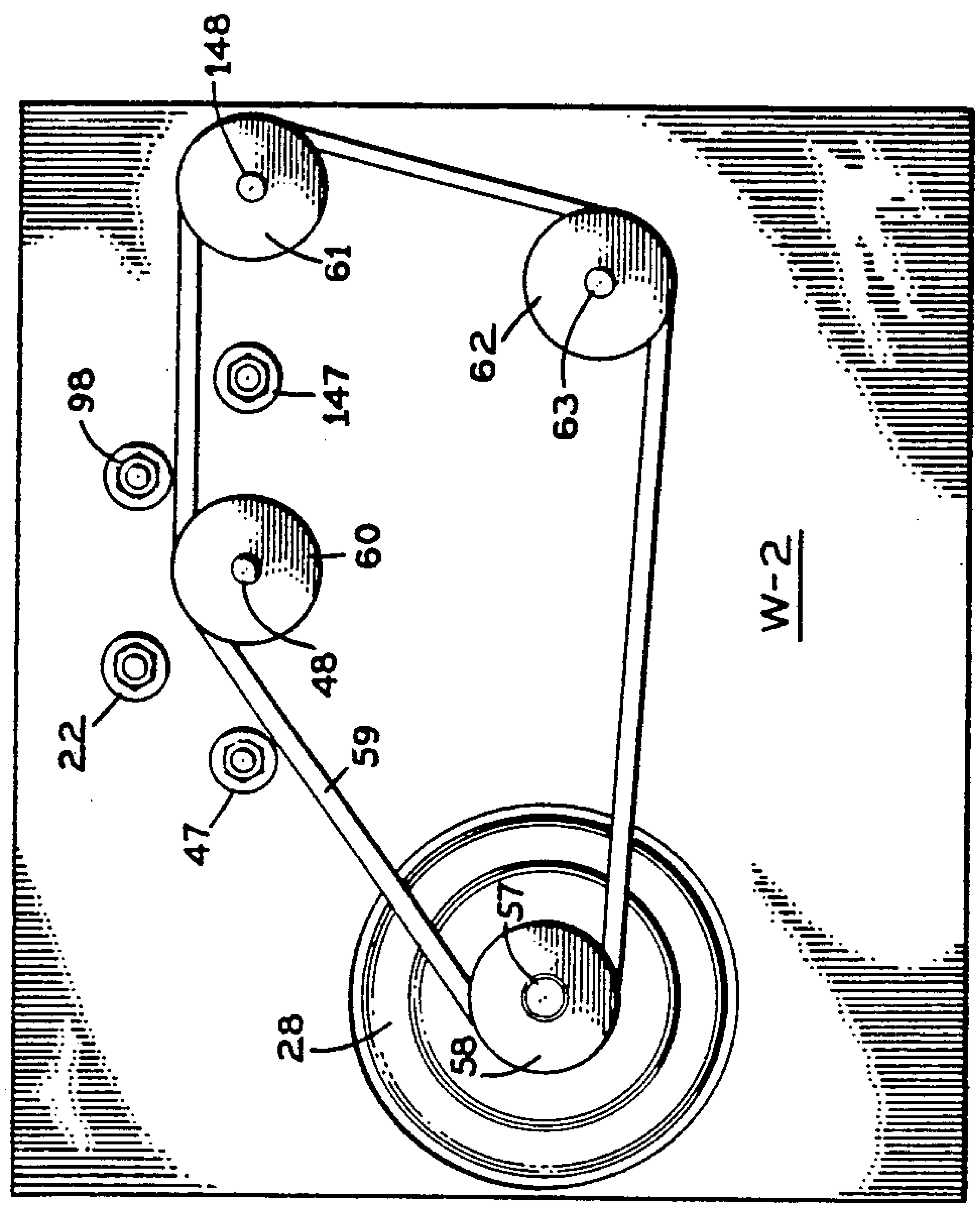


FIG. 4

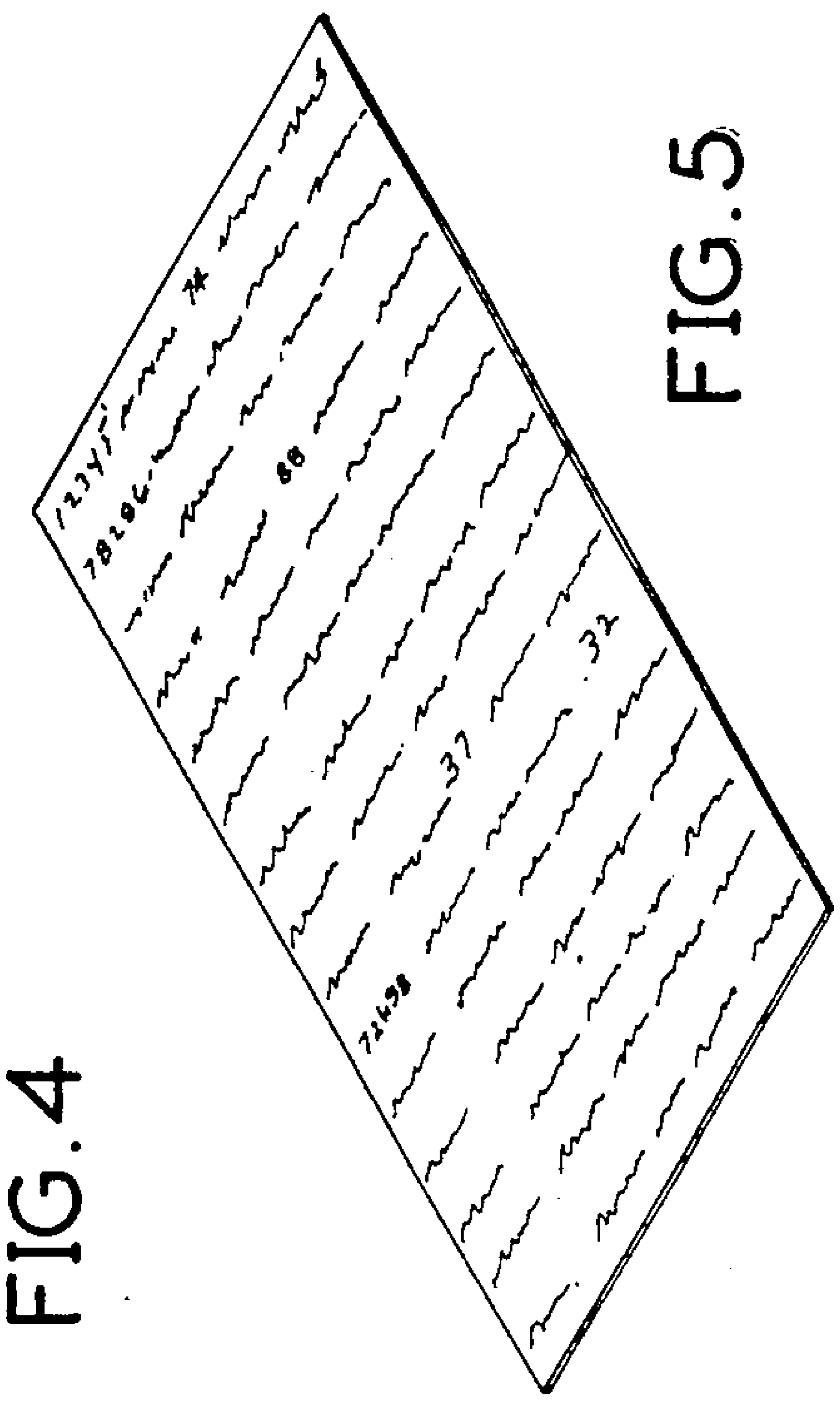


FIG. 5

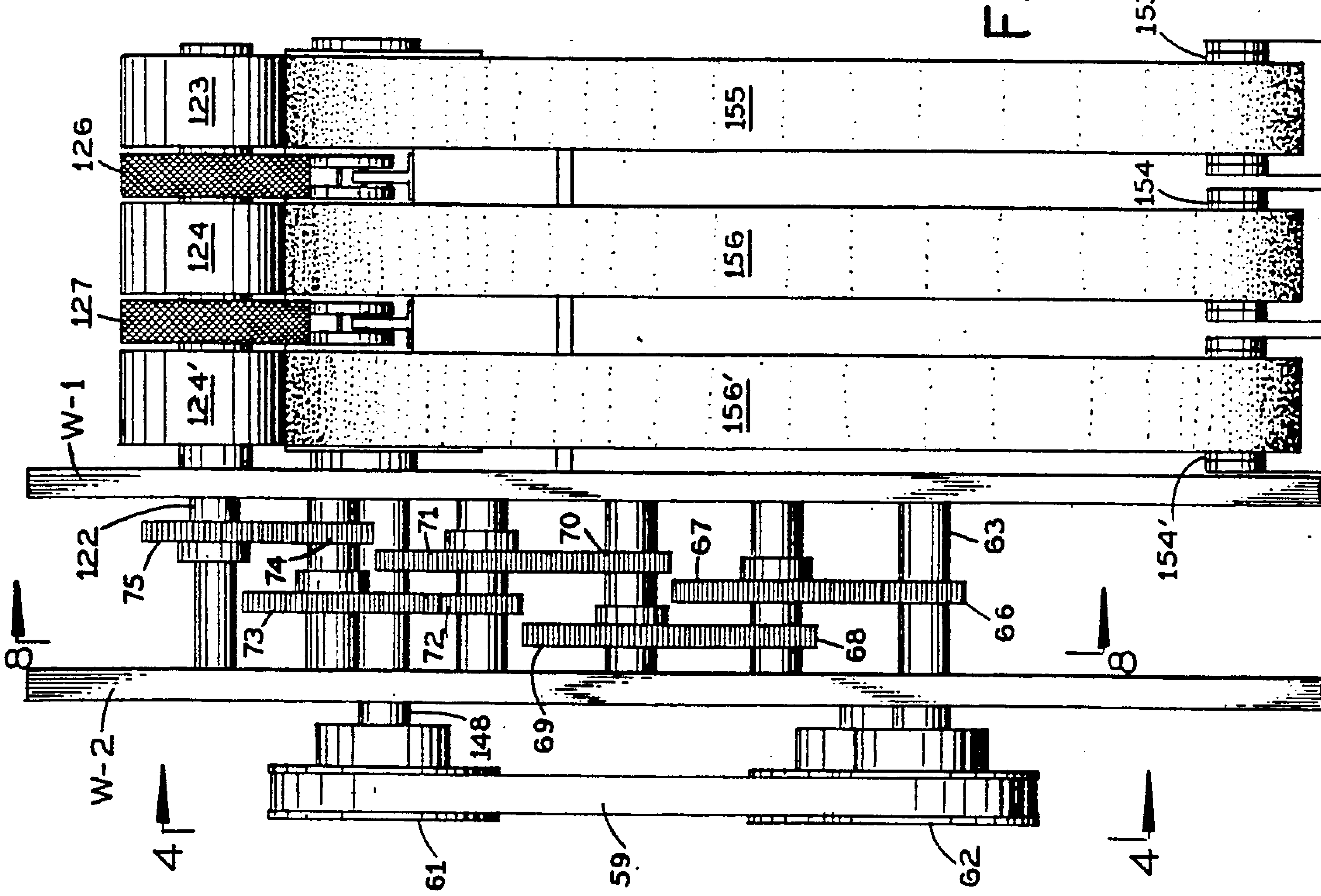


FIG. 3

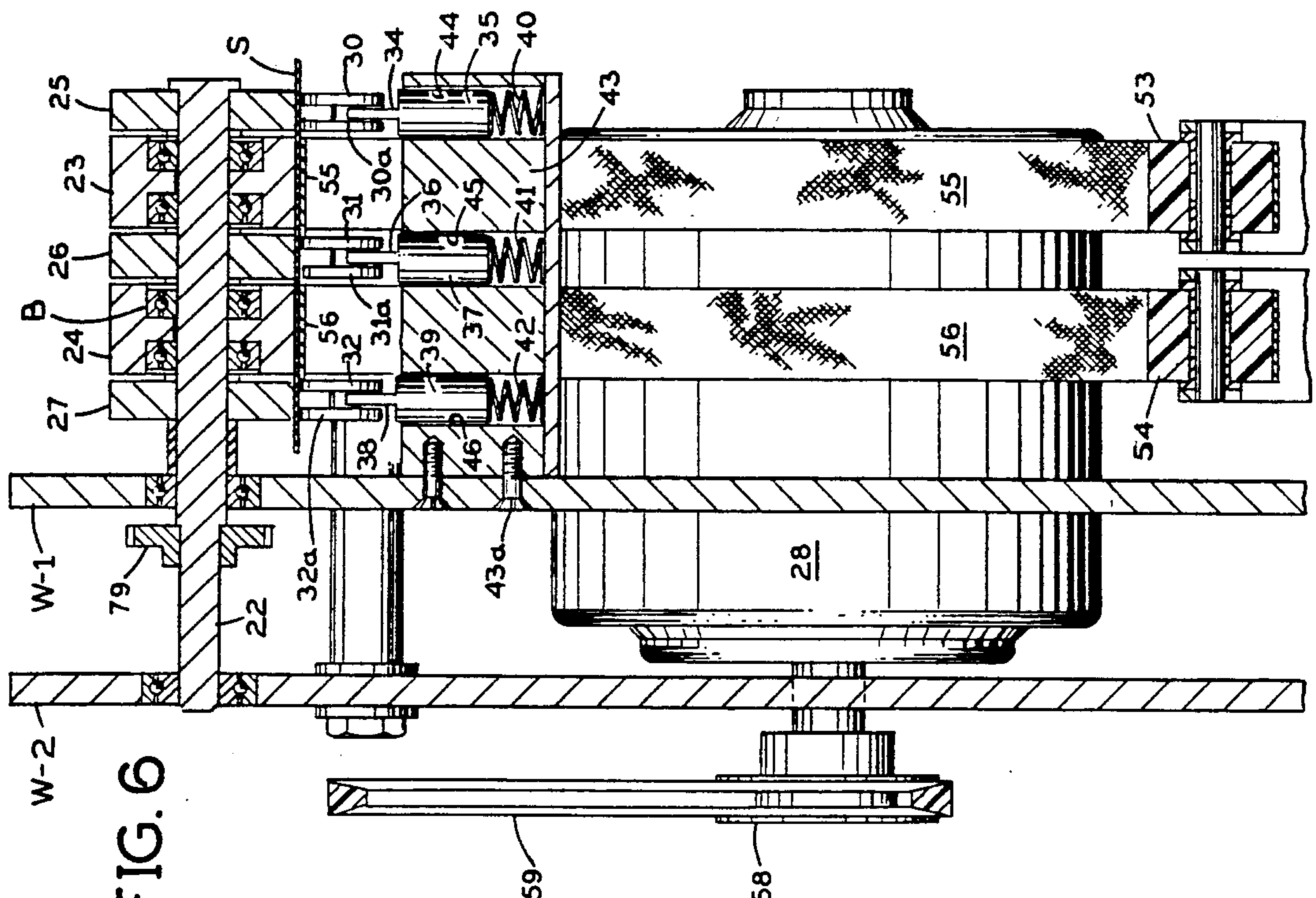

S
30
34
44
35
40
25
23
26
B
24
27
55
30a
31
36
45
41
43
56
31a
37
39
42
32
38
46
32a
43a
W-1
79
22
W-2
28
55
56
53
54
59
58

FIG. 6

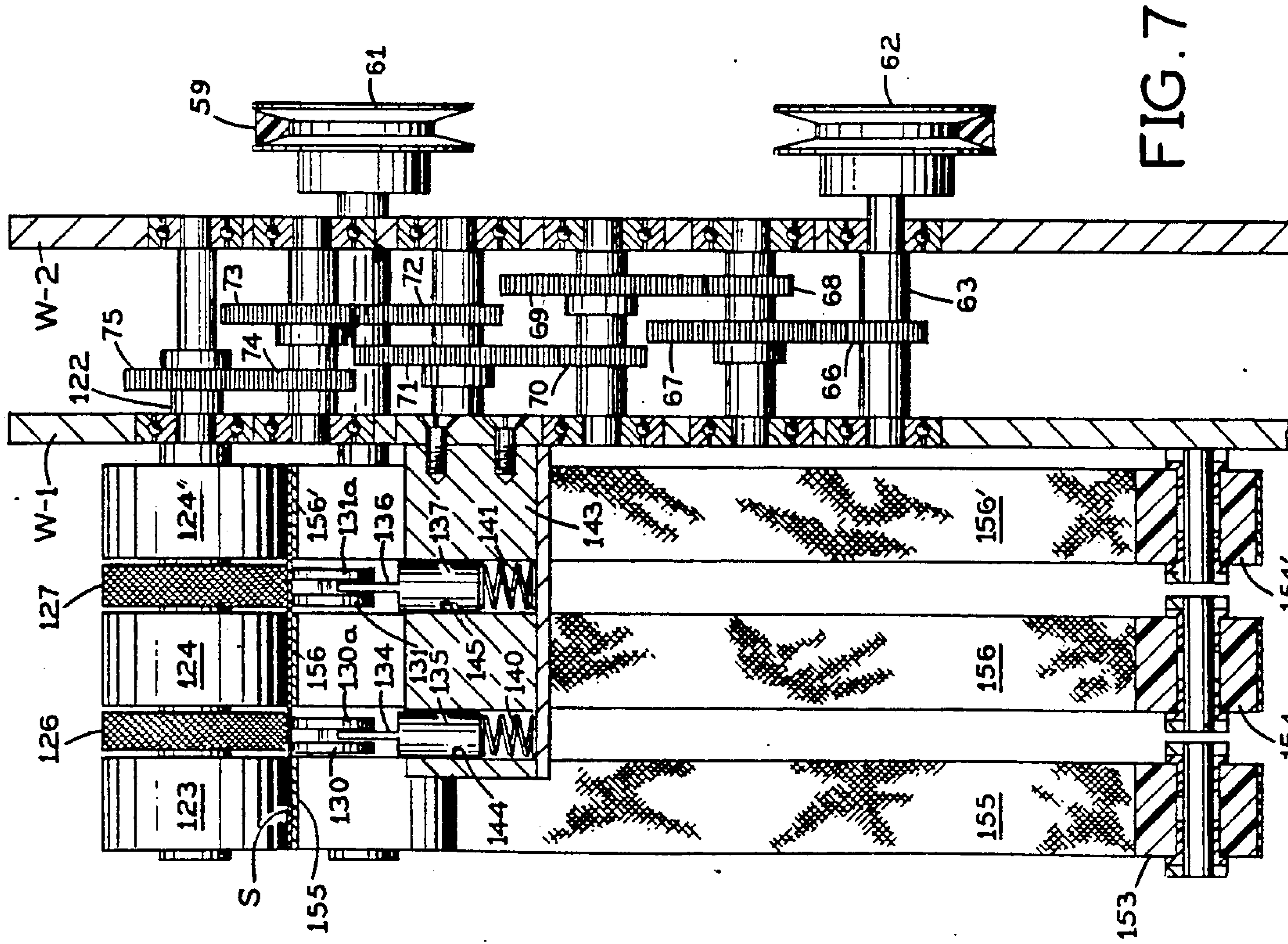

59
61
62
W-2
73
72
69
68
63
75
74
71
70
67
66
122
W-1
124"
156'
131a
136
137
141
143
127
124
156
130a
131
135
145
140
126
134
123
130
144
155
S
154'
154
153

FIG. 7

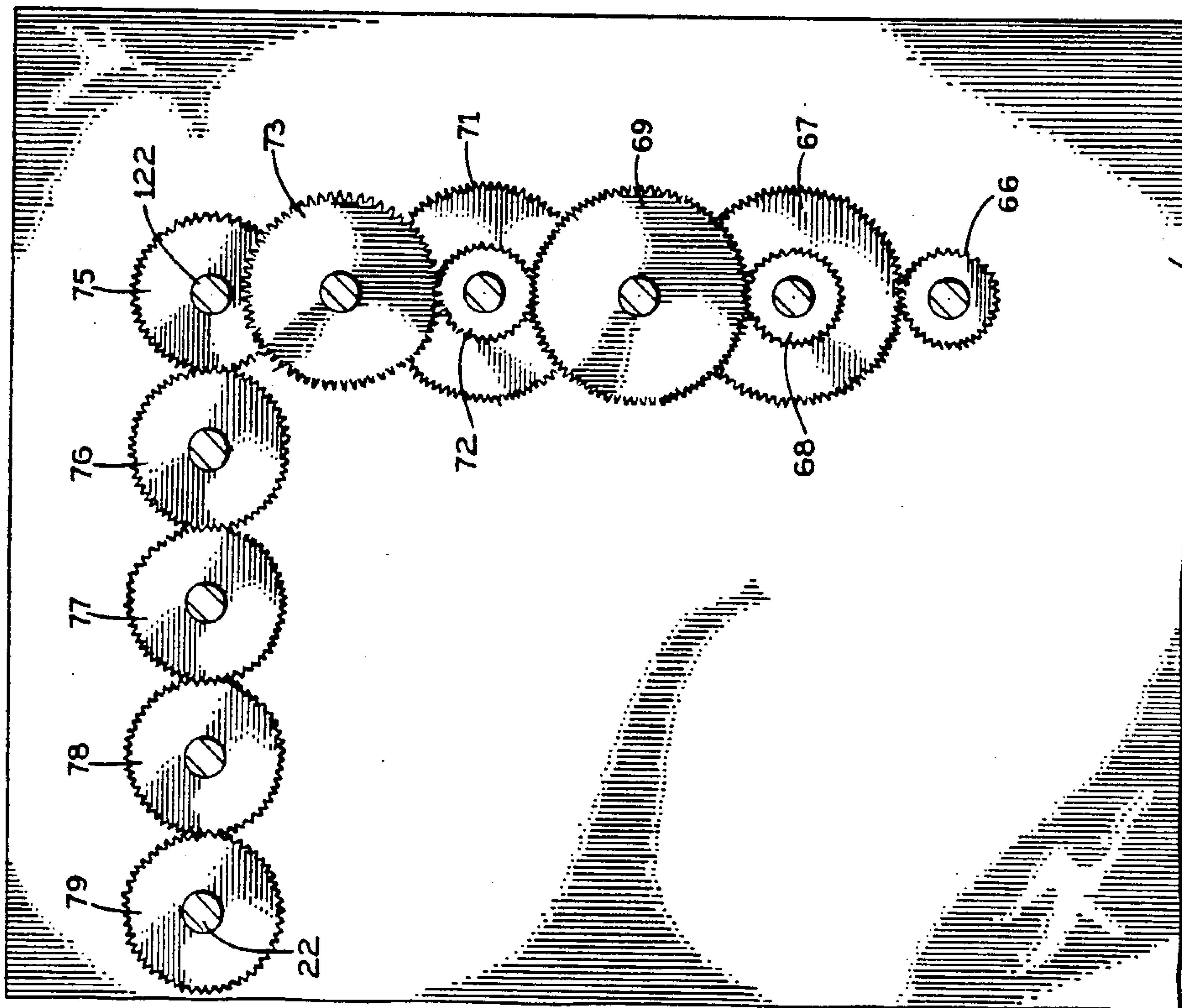


FIG. 8

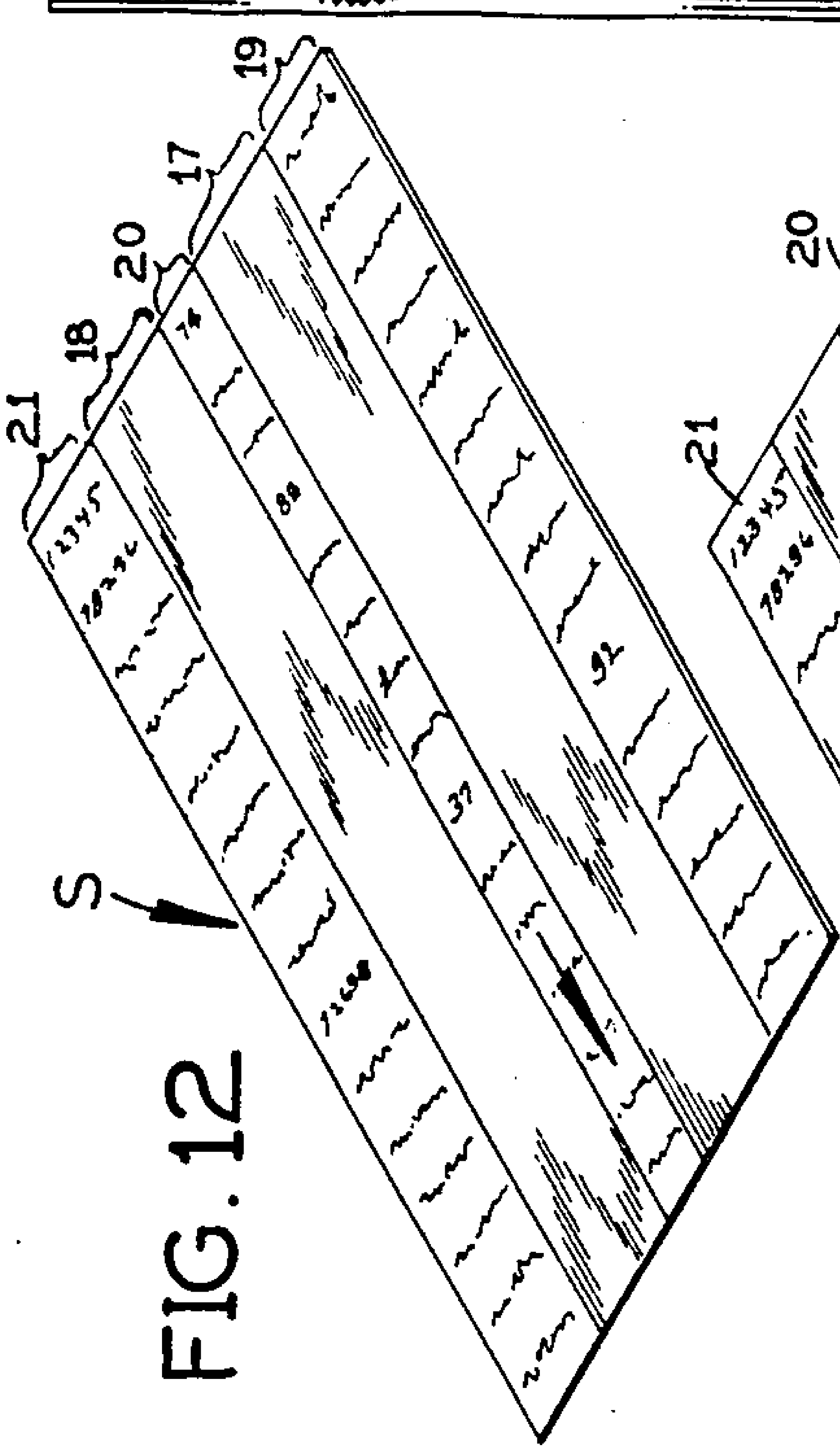


FIG. 12

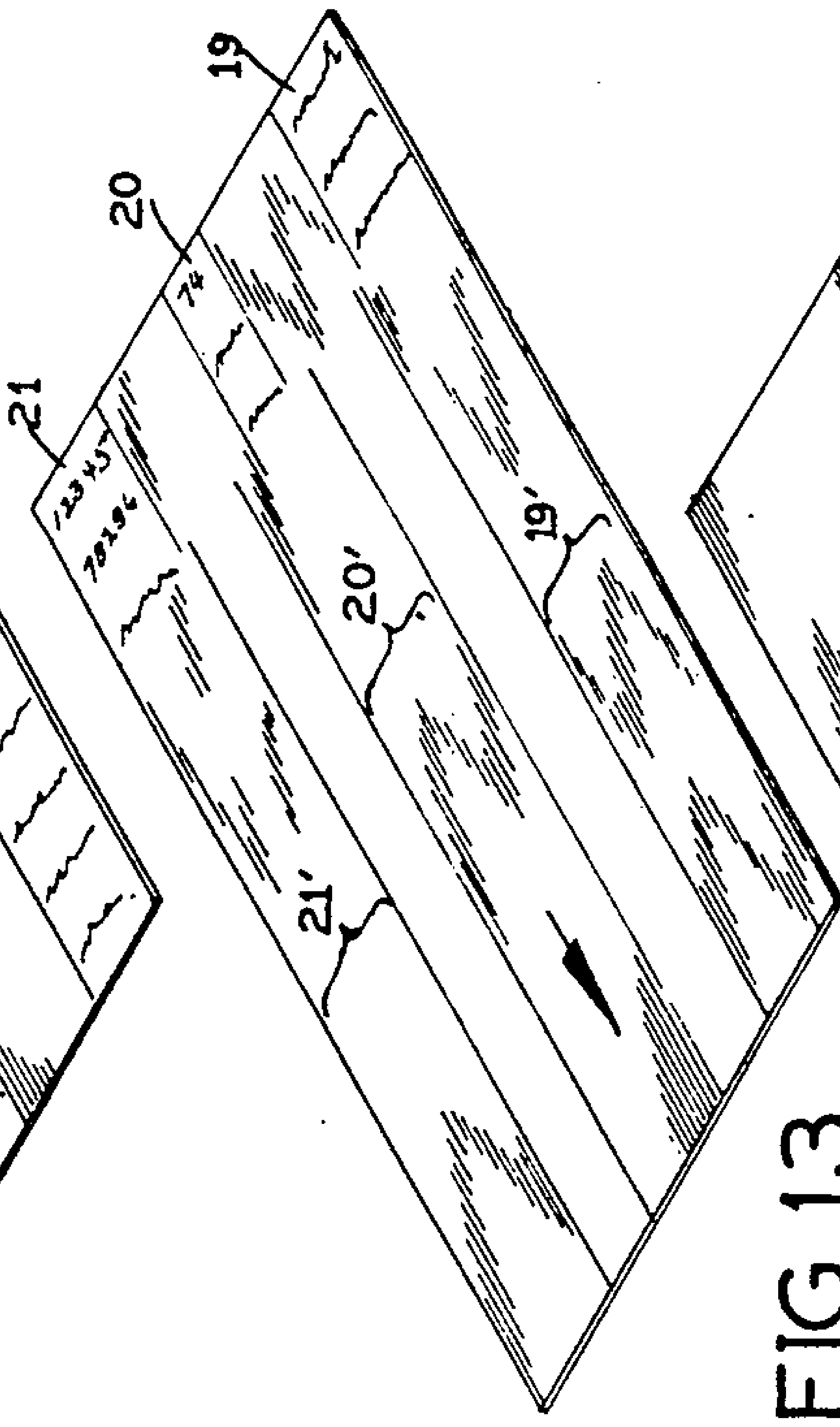


FIG. 13

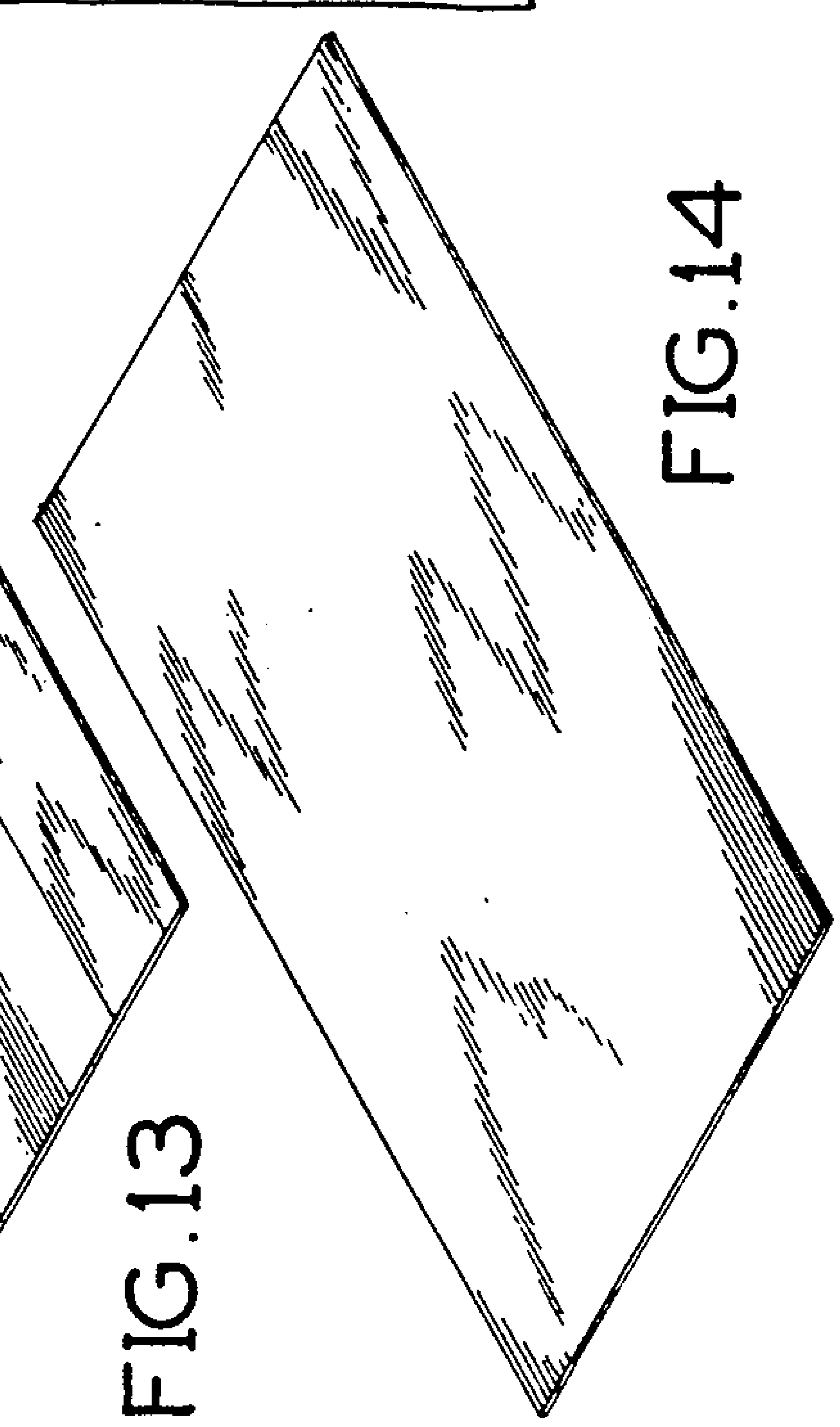


FIG. 14

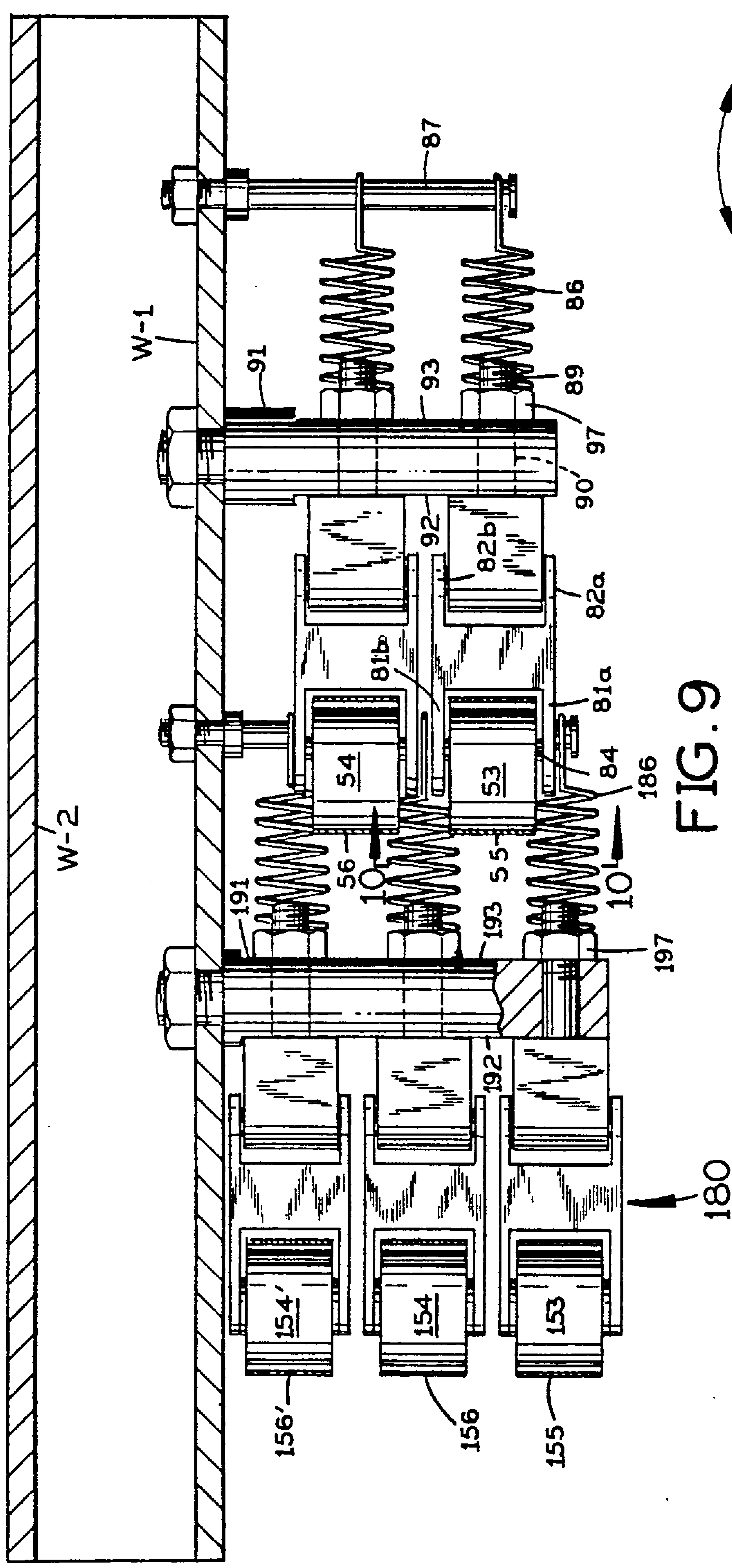

W-2
W-1
87
86
91
93
89
97
90'
92
82b
82a
81b
81a
84
186
54
53
56
55
10
191
193
197
192
180
154'
154
153
156'
156
155

FIG. 9

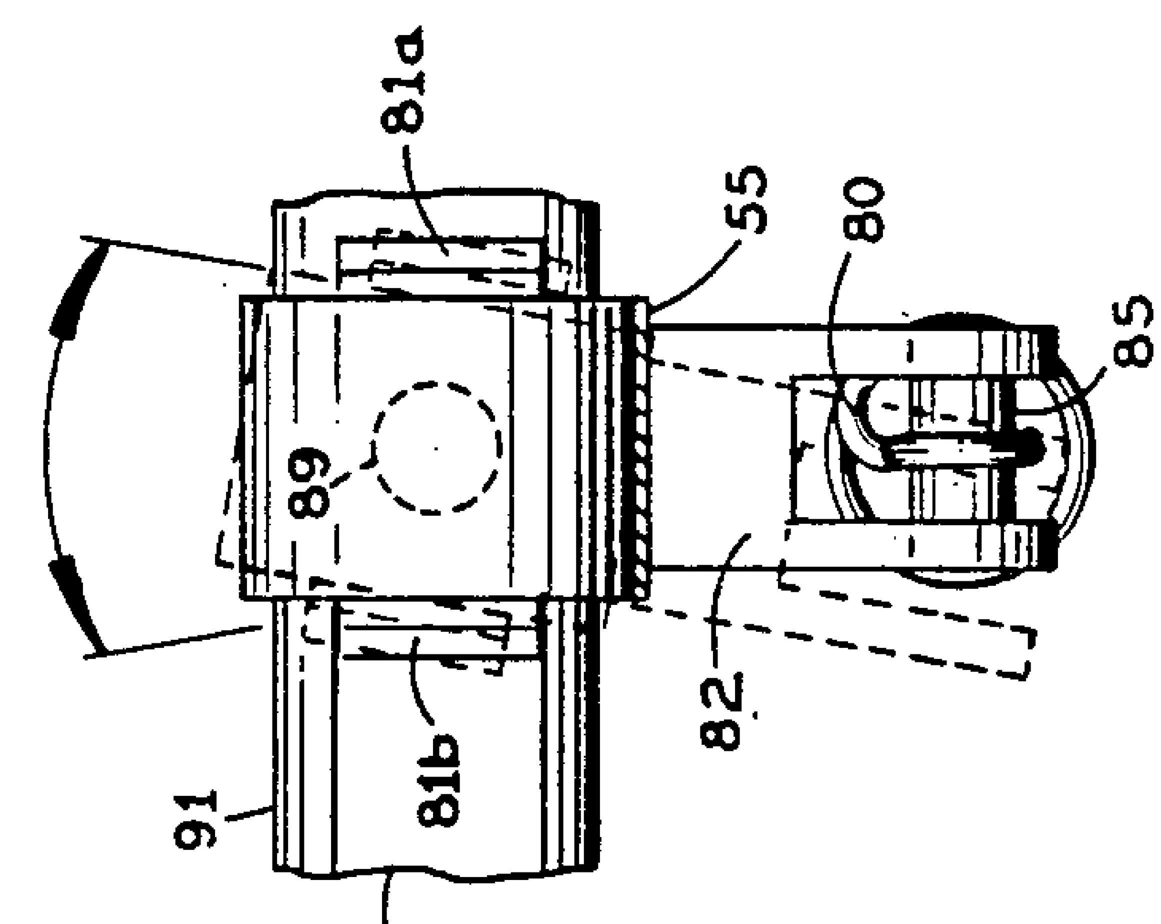

81a
55
80
85
89
82
81b
91
92

FIG. 10

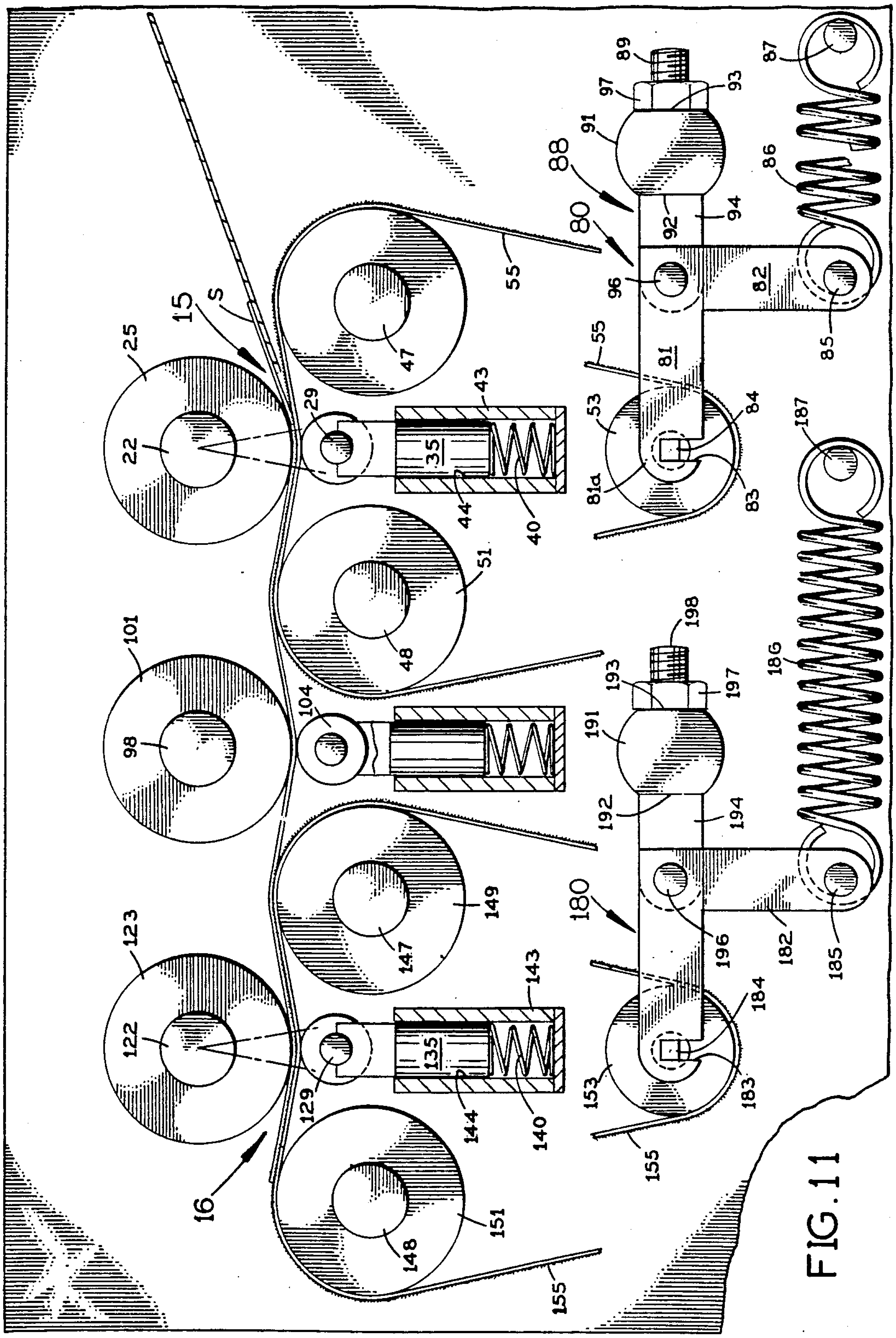

15
S
16
22
25
29
35
40
43
44
47
48
51
53
55
80
81
81a
82
83
84
85
86
87
88
89
91
92
93
94
96
97
98
101
104
122
123
129
135
140
143
144
147
148
149
151
153
155
180
182
183
184
185
186
187
191
192
193
194
196
197
198

FIG. 11

APPARATUS AND METHOD FOR REMOVING PHOTOGRAPHIC IMAGES FROM A FLEXIBLE FILM MEMBER

This invention relates to an apparatus and method for removing photographic images from a flexible photographic film member, such as a microfiche or a roll of film.

BACKGROUND OF THE INVENTION

Mylar film, either in microfiche form or in a roll, often is used for photographically recording highly sensitive information. Mylar film is a highly oriented polyester. When the decision is made to destroy this recorded information it is necessary that the destruction be so complete as to eliminate the possibility that an unauthorized person might reconstruct a useful amount of the putatively destroyed information.

My copending U.S. patent application Ser. No. 07/299,796, filed Jan. 23, 1989, discloses an apparatus for scraping photographic images from a Mylar or other film member which comprises:

feed rollers and pressure rollers for advancing the film member along a predetermined straight-line path without slippage between the feed rollers and the film member;

a first abrading roller and pressure rollers for scraping off segments of the photographic images at certain locations across the width of the film member.

a second abrading roller nd pressure rollers for scraping off the remaining segments of the photographic images at their locations across the width of the film member;

and a motor drive arrangement for the feed rollers and the abrading rollers which rotates the abrading rollers at a much higher surface speed than the feed rollers, so that the surface speed of each abrading roller is much higher than the speed of the film member moving tangentially past it.

The pressure rollers that coact with the feed rollers are heavily spring-biased toward the feed rollers to prevent slippage of the film member, and the pressure rollers that coact with the abrading rollers are of relatively soft yieldable material and are lightly spring biased toward the abrading rollers. The scraping action of each abrading roller takes place on the film member at a different location along its path than the clamping action of each feed roller and the respective pressure roller so that any given longitudinal segment of the film member sequentially experiences clamping, abrading and clamping actions.

SUMMARY OF THE INVENTION

The present invention is directed to a novel apparatus ana method for scraping photographic images from a flexible film member, particularly a Mylar microfiche or film roll.

Another object of this invention is to provide such an apparatus in which all the photographic images are removed from the film member in a single transit of the film member through the apparatus.

Another object of this invention is to provide such an apparatus which has endless flexible abrasive belts, such as sanding belts, that are deflected to follow the peripheral contour of corresponding rollers over enough of the roller circumference to achieve a very effective and thorough scraping of photographic images from a flexible film member advancing between the belts ana the roller surfaces.

Another object of this invention is to provide a novel method of removing photographic images from a flexible film member in which a predetermined area of the film member is advanced and clamped between opposed rollers and simultaneously is scraped by an endless flexible abrasive belt, with both the film member and the abrasive belt being deflected to follow the peripheral contour of one of the rollers over a substantial part of that roller's peripheral extent.

Preferably, the present invention comprises first and second abrading stations through which a flexible film member is conveyed in succession, each abrading station having:

endless flexible abrasive belts, each passing from an idler roller to a belt-drive roller and deflected downward from a straight-line path between them by a corresponding belt-deflection roller above, which causes the respective belt to follow the peripheral contour of the bottom of the belt deflection roller over a circumferential extent of several degrees, preferably about 20 degrees;

power driven film-advance rollers coaxial with the belt-deflection rollers ana of substantially the same diameter as the belt deflection rollers and positioned outside the abrasive belts to engage the top of a film member inserted onto the belts between the idler and belt-deflection rollers;

spring-biased pressure rollers below the film advance rollers which hold the film member up against the film advance rollers;

and lower rollers which tension the belts so that they follow the peripheral contour of the belt-deflection rollers et the bottom.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation of the working parts of the present apparatus;

FIG. **2** is a top plan view of this apparatus;

FIG. **3** is an end elevation taken form the left end of FIGS. **1** and **2**;

FIG. **4** is a side elevation taken from the line **4—4** in FIG. **3** and showing the drive motor, belt and pulleys in the drive mechanism of this apparatus;

FIG. **5** is a top perspective view of a sheet of Mylar with photographic images shown schematically on one face which the present apparatus removes;

FIG. **6** is a vertical cross-section taken along the line **6—6** in FIG. **1** and showing the Mylar sheet engaged between a first set of rollers above and sanding belts and pressure rollers below;

FIG. **7** is a vertical cross-section taken along the line **7—7** in FIG. **1** and showing the Mylar sheet engaged between a second set of rollers above and sanding belts and pressure rollers below, as well as the gear drive to the rollers;

FIG. **8** is an end elevation of the gear drive taken from the vertical section line **8—8** in FIG. **3**;

FIG. **9** is a horizontal longitudinal section taken along the line **9—9** in FIG. **1** and showing the belt tensioning and positioning mechanism in the present apparatus;

FIG. **10** is an end elevation taken from the line **10—10** in FIG. **9** and showing part of the belt tensioning and positioning mechanism;

FIG. **11** is an enlarged elevation, with parts broke away, showing working parts of the present apparatus;

FIG. 12 is a top perspective view of the Mylar sheet after passing the first set of sanding belts to remove two parallel tracks of photographic images and before reaching the second set of sanding belts in the apparatus;

FIG. 13 is a similar view of the Mylar sheet showing schematically the removal of remaining tracks of photographic images along its length; and

FIG. 14 is a similar view of the Mylar sheet after it has been scraped clean in the present apparatus.

Before explaining the disclosed embodiment of the present invention in detail it is to be understood that the invention is not limited in its application to the details of the particular arrangement shown since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.

DETAILED DESCRIPTION

Referring to FIG. **1**, in broad outline the present apparatus has a first abrading station **15** and a second abrading station **16** through which a Mylar sheet with photographic images on it moves in succession (from right to left in FIG. **1**). As shown ia FIG. **12**, ia the first abrading station **15** two laterally spaced parallel tracks **17** and **18** of the photographic images ere removed from the Mylar sheet S, leaving three parallel tracks **19**, **20** and **21** of the photographic images still on the film. As indicated in FIG. **13**, in the second abrading station **16** the Mylar sheet S is scraped along three parallel tracks **19**′, **20**′ and **21**′ which include, and are slightly wider than, the tracks **19**, **20** and **21**. Tracks **19**′ and **20**′ partially overlap the track **17** along its opposite edges, and tracks **20**′ and **21**′ partially overlap the track **18** along its opposite edges. Coming out of the second abrading station **16**, the Mylar sheet S has had all of the photographic images removed, as shown ia FIG. **14**.

Referring to FIGS. **1**, **2** and **6**, the first abrading station **15** of the apparatus has a horizontal upper drive shaft **22** which carries an upper roller assembly comprising a pair of relatively wide, smooth surfaced, cylindrical, upper, belt-deflection rollers **23** and **24** of rubber or rubber-like material and three narrower, knurled film-advance rollers **25**, **26** and **27**, all of the same diameter and coaxial with one another and all engageable with the Mylar sheet S from above. Each roller **23** and **24** is a belt-deflection means in the present apparatus, and each roller **25**, **26** and **27** is a film advance means, as explained hereinafter. The knurled film-advance roller **26** is between the belt-deflection rollers **23** nd **24**, the knurled film-advance roller **25** is on the opposite side of roller **23** from roller **26** and the other knurled film advance roller **27** is on the opposite side of roller **24** from roller **26**.

Shaft **22** is driven from an electric motor **28**, as explained hereinafter. The film-advance rollers **25**, **26** and **27** are rigidly affixed to shaft **22** to rotate in unison with it. The belt-deflection rollers **23** and **24** are mounted on ball bearings B on shaft **22** so they do not rotate in unison with it.

As shown in FIG. **6**, at its end remote from rollers **23–27** the drive shaft **22** is rotatably supported in ball bearings B in a vertical housing wall W 2. Also, shaft **22** is rotatably supported in bearings in an inner housing wall **W-1** closer to the film-advance roller **27**. Most of the length of shaft **22** is on the opposite side of wall **W-1** from wall **W-2**, and this length of the shaft (carrying rollers **23–27**) is cantilevered.

Vertically below the upper roller shaft **22**, respective horizontal shafts carry three pairs of smooth surfaced, cylindrical pressure rollers **30** and **30***a*, **31** and **31***a*, and **32** and **32***a* (FIG. **6**). These pressure rollers are of the same diameter as each other and of substantially smaller diameter than the upper rollers **23**, **24**, **25**, **26** and **27**. Each pair of rollers **30** and **30***a*, **31** and **31***a*, and **32** and **32***a* and the respective shaft may be a one-piece nylon body and they constitute a pressure means in this apparatus. Pressure rollers **30** and **30***a* are directly below the knurled film-advance roller **25**. Pressure rollers **31** end **31***a* are directly below the knurled film advance roller **26**. Pressure rollers **32** and **32***a* are directly below the knurled film-advance roller **27**. None of the pressure rollers **30**, **30***a*, **31**, **31***a*, **32** or **32***a* is directly below either belt-deflection roller **23** or **24**. The respective shafts for these paired rollers are rotatably supported from below by: a yoke **34** projecting up from a plunger **35** and slidably received between rollers **30** and **30***a*, a yoke **36** projecting up from a plunger **37** and slidably received between rollers **31** and **31***a*, and a yoke **38** projecting up from a plunger **39** and slidably received between rollers **32** and **32***a*. Plungers **35**, **37** and **39** are vertically displaceable and are urged upward by respective springs **40**, **41** and **42**. A housing block **43** provides: a vertical cylinder **44** which slidably receives plunger **35** and its spring **40**, a vertical cylinder **45** which slidably receives plunger **37** and its spring **41**, and a vertical cylinder **46** which slidably receives plunger **39** and its spring **42**. Housing block **43** is rigidly attached to housing wall **W-1** by screws **43***a*.

The first abrading station **15** has: a horizontal first idler shaft **47** FIG. **1**) on the entry side of the pressure rollers **30**, **30***a*, **31**, **31***a*, **32** and **32***a*, and a horizontal belt drive shaft **48** on the exit side of these pressure rollers. As shown in FIG. **2**, idler rollers **49** and **50** on shaft **47** are aligned lengthwise of the apparatus with the belt-deflection rollers **23** and **24**, respectively, on the entry side of the latter. Likewise, the belt drive shaft **48** carries belt drive rollers **51** and **52**, which are aligned longitudinally of the apparatus with rollers **23** and **24**, respectively, on the exit side of the latter. The idler rollers **49** and **50** and the belt drive rollers **51** and **52** have the same diameter as rollers **23** nd **24**. As shown in FIG. **1**, the top of the idler rollers **49** and **50** on the entry side is above the bottom of the periphery of the belt deflection rollers **23** and **24**, and the top of the belt drive rollers **51** and **52** on the exit side is above the bottom of the periphery of the belt-deflection rollers **23** and **24**.

In the first abrading station **15**, a first tensioning roller **53** (FIGS. **1** and **6**) is spaced vertically below the belt-deflection roller **23** and a second tensioning roller **54** (FIG. **6**) is located vertically below the belt-deflection roller **24**. Each tensioning roller **53** and **54** is individually angularly adjustable as explained hereinafter.

In the first abrading station **15**, a first flexible, endless, sanding belt **55** passes up around the first tensioning roller **53** to the idler roller **49** on the entry side, across the top of roller **49** and from right to left in FIG. **1** across the bottom of the belt-deflection roller **23**, round the top of the belt drive roller **51** on the exit side, and back down to the tensioning roller **53**. As shown in FIG. **6**, belt **55** has a width between its opposite longitudinal edges which is less than the space between the knurled film-advance rollers **25** and **26** and it passes between the pressure rollers **30***a* and **31** without engaging either of them. Between rollers **49** and **51** this sanding belt is deflected downward in FIG. **1** as it passes under the belt-deflection roller **23** and it engages roller **23** over about 20 degrees circumferentially on the bottom. Only the tension in the belt holds it up against roller **23** over this bottom circumferential port of the roller.

An identical second flexible sanding belt **56** (FIG. **6**) has the same path of travel up from the second tensioning roller **54** to the other upper idler roller **50** on the entry side, across the top of roller **50** and across the bottom of the belt-deflection roller **24**, round the top of the corresponding belt drive roller **52** on the exit side, and down to the tensioning roller **54**. As shown ia FIG. **6**, belt **56** engages the belt deflection roller **24** across the full width of each but it does not engage either film-advance roller **26** or **27** or either pressure roller **31***a* or **32** on opposite sides of belt deflection roller **24**.

As best seen in FIG. **1**, the Mylar sheet S is fed down along an inclined ramp R into the first abrading station **15** on top of the sanding belts **55** and **56** as they leave the upper idler rollers **49** and **50** on the entry side. The bottom face of the Mylar sheet has photographic images that are to be destroyed and the outer face of the sanding belt is abrasive. The knurled film-advance rollers **25**, **26** and **27** directly engage the top of Mylar sheet S and force it down against the paired pressure rollers **30** and **30***a*, **31** and **31***a*, and **32** and **32***a* below so that these upper nd lower rollers vance the Mylar sheet through the first abrading station from right to left in FIG. **1**. The Mylar sheet passes beneath the belt deflection rollers **23** and **24** with its bottom face engaging the outer abrasive face of each sanding belt **55** and **56**. The tension in these sanding belts holds them up against the Mylar sheet as it passes down under the upper rollers **23–27** and causes the belts to closely follow the peripheral contour of the respective belt deflection rollers **23** and **24** over about **20** degrees of their circumference on the bottom. Therefore, the abrading action of the sanding belts takes place over about **20** degrees of the circumference of the belt-deflection rollers **23** and **24**.

In one practical embodiment, the speed of the Mylar sheet S (as determined by the rotational speed and diameter of the knurled film-advance rollers **25**, **26** and **27**) is about 15–20 feet per minute and the speed of the abrasive belts **55** and **56** is about 1000 feet per minute. Therefore, any given line across the longitudinal tracks **17** and **18** on the film sheet is scraped many times by the abrasive particles on the much faster moving abrasive belts. Also, this scraping or abrading action takes place on the film member over about 20 degrees circumferentially where it is being clamped by the action of pressure rollers **30**, **30***a*, **31**, **31***a*, **32** and **32***a* holding the Mylar film sheet up against the motor-driven film-advance rollers **25**, **26** and **27**.

As shown in FIGS. **2** and **6**, drive motor **28** has an output shaft **57** carrying a pulley **58** which drives an endless flexible belt **59**. As shown in FIG. **4**, belt **59** drives three spaced pulleys **60**, **61** and **62**. Pulley **60** is on shaft **48** which carries the belt drive rollers **51** and **52** in the first abrading station **15**. Pulley **61** is on a shaft **148** in the second abrading station **16**. As shown in FIG. **3**, pulley **62** is connected to a shaft **63** which carries a gear **66**. Pulleys **58**, **60**, **61** and **62** are located outside the housing wall W-**2**, as shown in FIG. **2**.

As shown in FIGS. **3**, **7** and **8**, the drive to the upper drive shaft **22** in the first abrading station **15** of the apparatus comes from gear **66** via speed-reducing gears **67**, **68**, **69**, **70**, **71**, **72**, **73**, **74** and **75**, and gears **76**, **77**, **78** and **79** (FIG. **8**). These gears are located between the housing walls W-**1** and W-**2**, as shown in FIG. **7**. The shafts which carry gears **66–79** are rotatably supported by ball bearings B in housing walls W-**1** and W-**2**.

Referring to FIGS. **11** and **9**, the vertical position of the tensioning roller **53** end thus the tension on sanding belt **55** is determined by a generally right-angled lever **80** (FIG. **11**) having a generally horizontal upper leg **81** nd a generally vertical leg **82** extending down from it.

As shown ia FIG. **9**, the upper leg **81** of the lever is bifurcated at its end away from its vertical leg **82**, presenting laterally spaced free end segments **81***a* and **81***b*. As shown in FIG. **11**, the free end segment **81***a* has a rectangular recess **83** which is open at the bottom. The other free end segment **81***b* has an identical recess (not shown) which is aligned with recess **83**. A shaft **84** which carries roller **53** is received in the upper ends of these recesses.

The vertical leg **82** of lever **80** has a bifurcated lower end at which it carries a cross pin **85**. A coil spring **86** is under tension between cross pin **85** and a fixedly mounted cross pin **87** at the opposite end of the spring. Cross pin **87** is rigidly mounted ia housing wall W-**1** (FIG. **9**). Spring **86** pulls the right-angled lever **80** counter-clockwise in FIG. **11** and thereby pulls down on the tensioning roller **53**.

The angular position of tensioning roller **53** is adjustable by an adjusting screw member **88**, which has a screw-threaded stem **89** extending slidably through a cross bore **90** (FIG. **9**) in a fixedly mounted horizontal shaft **91**, which presents a flattened vertical face **92** on its side toward the right-angled lever **80** and a flattened vertical face **93** on its opposite side. Shaft **91** is fixedly mounted in housing wall W-**1**. The vertical leg **82** of lever **80** is bifurcated at its upper end, presenting opposite segments **82***a* and **82***b*. The adjusting screw member **88** has an enlarged rectangular head segment **94** which is snugly received between the opposite segments **82***a* and **82***b* of the bifurcated upper end of vertical leg **82**. A cross pin **96** pivotally connects segment **94** of the adjusting screw to the right-angled lever **80** at this corner of the lever. A nut **97** threadedly engages the stem **89** of the adjusting screw next to the flattened face **93** of fixed shaft **91**.

The tensioning roller **53** can be adjusted angularly about the axis of the adjusting screw **88** by loosening the nut **97** and turning the adjusting screw in one direction or the other and then re tightening the nut. The lever **80** turns in unison with the adjusting screw **88** and the roller **53** moves with lever **80**. For example, as shown in FIG. **10**, the tensioning roller **53** can be adjusted from the position shown in full lines to the position shown in phantom if this is necessary for proper alignment between tensioning roller **53** and sanding belt **55**.

The tensioning roller **54** for sanding belt **56** has an identical arrangement enabling it to be adjusted in the manner just described for roller **53**. This adjustment arrangement is partially shown in FIG. **9**.

Referring to FIGS. **1** and **11**, on the exit side of the first abrading station **15** an upper drive shaft **98** supports a laterally spaced pair of smooth surfaced, cylindrical rollers **99** and **100** of rubber or rubber like material (FIG. **2**), which are identical to and longitudinally aligned with the belt-deflection rollers **23** and **24**, respectively, in the first abrading station **15**. Shaft **98** also carries knurled film advance rollers **101**, **102** and **103** which correspond to the film-advance rollers **25**, **26** and **27** in the first abrading station. Shaft **98** carries the previously mentioned gear **77** and is driven from motor **28** through the belt-and-pulley drive and the gear drive already described.

Directly below these drive rollers are spring-loaded pressure rollers **104** like the pressure rollers **30**, **30***a*, **31**, **31***a*, **32** and **32***a* (FIG. **6**) ia the first abrading station.

As shown in FIG. **11**, the Mylar sheet after coming out of the first abrading station **15** passes between the upper rollers **99** and **100** on shaft **98** and the pressure rollers **104** below.

The second abrading station **16** is substantially identical to the first abrading station **15** except that it has three instead of two sets of belt-deflection rollers and sanding belts and these are offset laterally from those in the first abrading station so as to remove the three remaining tracks **19**, **20** and **21** of photographic images (FIG. **13**) which remain on the Mylar sheet S after it has passed through the first abrading station.

Elements in the second abrading station which correspond to those in the first are given the same reference numerals plus **100** as the elements in the first abrading station with the exception that the third set of elements has a "prime" suffix added to each. For example, in the second abrading station the belt deflection rollers are designated by reference numerals **123**, **124** and **124'** (FIG. 2).

The mode of operation in the second abrading station **16** is identical to what happens in the first abrading station **1** except for the location of the tracks of photographic images on the Mylar sheet that are removed. Therefore, a complete detailed description of the elements in the second abrading station and the mode of operation there is considered unnecessary.

As shown in FIGS. **2** and **7**, in the second abrading station of the apparatus a horizontal shaft **122** is attached to gear **75**. Shaft **122** rotatably supports three belt-deflection rollers **123**, **124** and **124'** by means of ball bearings and two knurled film-advance rollers **126** and **127** are affixed to shaft **122** to rotate in unison with it. Roller **126** is between rollers **123** and **124**, end roller **127** is between rollers **124** and **124'**. Paired pressure rollers **130** and **130***a*, and **131** and **131***a*, are resiliently supported below the film-advance rollers **126** end **127** by spring-biased plungers **135** and **137**. Three flexible endless sanding belts **155**, **156** and **156'** respectively pass beneath rollers **123**, **124** and **124'**. Belt **155** does not engage the adjacent pressure roller **130**. Belt **156** does not engage the adjacent pressure rollers **130***a* and **131**. Belt **156'** does not engage the adjacent pressure roller **131***a*. The Mylar sheet S passes over the upper run of abrasive belts **155**, **156** and **156'** and is engaged from above by rollers **123**, **126**, **124**, **127** and **124'**. The knurled film-advance rollers **126** and **127**, rotating in unison with shaft **122**, advance the Mylar sheet through the second abrading station in the same manner that the knurled rollers **25**, **26** and **27** in the first abrading station move it through that station.

With this arrangement superior results are achieved because of the "partial wrap-around" path each sanding belt takes under the corresponding belt-deflection roller **23**, **24**, **123**, **124** or **124'**. The linear speed of the sanding belt is several times that of the Mylar sheet S, as determined by the surface speed of the knurled film-advance rollers (**25**, **26** and **27** in the first abrading station; **126** and **127** in the second abrading station). Therefore, the sanding belts have an extremely effective scraping action such that no significant trace of photographic image remains on the corresponding longitudinal tracks on the Mylar sheet S. The Mylar sheet is completely scraped free of photographic images after it has gone through the first and second abrading stations **15** and **16** just once.

From the foregoing description and the accompanying drawings it will be evident that, in accordance with this invention, the area of the film member that is being scraped at any given instant also is being clamped between the film-advance rollers ana the corresponding pressure rollers. This simultaneous clamping and scraping contributes to the effectiveness and thoroughness with which the photographic images are removed from the film member.

I claim:

1. A photographic image removal apparatus for use with a flexible film member having photographic images on one face thereof, said apparatus comprising:

an endless flexible belt having an abrasive face and an opposite face;

belt drive means for moving said belt repeatedly along an endless path at a predetermined speed;

belt deflection means having a curved periphery in confronting relationship to said abrasive face of the belt and positioned to deflect said belt to follow the contour of said curved periphery for part of its extent;

means for tensioning said belt to thereby cause said belt to follow the contour of said curved periphery of said belt-deflection means for said part of its extent;

movable film-advance means next to said belt-deflection means, said film advance means having a periphery for engaging the film member beyond said belt;

drive means for moving said periphery of said film-advance means at e speed many times less than said predetermined speed of said belt;

and pressure means positioned in confronting relationship to said periphery of said film-advance means to engage the film member between them and cause said film member to move between said belt-deflection means and said belt substantially at the speed of said periphery of said film-advance means.

2. An apparatus according to claim **1** wherein:

said film-advance means moves said film member in the same general direction as the movement of said belt past said belt-deflection means.

3. An apparatus according to claim **1** and further comprising:

yieldable means biasing said pressure means toward said film-advance means to drivingly engage said film member between them.

4. An apparatus according to claim **1** wherein:

said belt-deflection means and said film-advance means are coaxial rollers of substantially the same diameter.

5. A photographic image removal apparatus for use with a flexible photographic film member having photographic images on one face thereof, said apparatus comprising:

an endless flexible belt having an abrasive face and an opposite face;

belt drive means for moving said belt repeatedly along an endless path at a predetermined speed;

belt-deflection roller means positioned along said path in confronting relationship to said abrasive face of the belt to deflect said belt to follow the peripheral contour of said belt-deflection roller means over a predetermined circumferential portion thereof;

film-advance roller means next to said belt-deflection roller means ana beyond said belt, said film-advance roller means being coaxial with and substantially the same diameter as said belt-deflection roller means;

drive means for rotating said film advance roller means at a peripheral surface speed thereof many times less than said predetermined speed of said belt;

and pressure roller means positioned in confronting relationship to said film advance roller means to engage the film member between them and force said film member between said belt deflection roller means and said belt at substantially said peripheral surface speed of said film-advance roller means.

6. An apparatus according to claim **5** and further comprising means for tensioning said belt to hold said belt contiguous to said predetermined circumferential portion of said belt-deflection roller means.

7. An apparatus according to claim **6** and further comprising:

spring means biasing said pressure roller means against said film-advance roller means.

8. An apparatus according to claim **7** wherein:

said film advance roller means moves said film member in the direction of travel of said belt past said belt-deflection roller means.

9. An apparatus according to claim **7** wherein:

said belt-deflection roller means end said film-advance roller means are above said abrasive face of the belt;

and said pressure roller means is below and substantially aligned vertically with said film-advance roller means.

10. An apparatus according to claim **7** wherein:

said belt drive means includes drive roller means located after said belt-deflection roller means along said path of said belt and engaging said opposite face of said belt from below, said drive roller means having the top of its periphery at a higher level than the bottom of the periphery of said belt-deflection roller means;

and further comprising:

idler roller means located ahead of said belt-deflection roller means along said path of said belt and engaging said opposite face of said belt from below, said idler roller means having the top of its periphery at a higher level than the bottom of the periphery of said belt deflection roller means.

11. An apparatus according to claim **10** and further comprising:

spring means holding said pressure roller means up against said film advance roller means.

12. An apparatus according to claim **10** end further comprising:

a tension roller spaced below said pressure roller means and engaging said opposite face of said belt from above;

and means urging said tension roller downward to tension said belt and hold said belt up contiguous to the bottom of said belt-deflection roller means.

13. An apparatus for removing photographic images from one face of a flexible Mylar film member comprising:

a first abrading station having:

a first set of laterally spaced belts, each having an abrasive outer face, an opposite inner face and opposite longitudinal edges;

belt drive means for moving said belts repeatedly along respective laterally spaced endless paths at a predetermined speed;

a first set of coaxial belt deflection rollers positioned respectively along said paths above said abrasive faces of the respective belts to deflect the corresponding belt downward to follow the peripheral contour of the respective belt-deflection roller over a predetermined circumferential bottom portion thereof;

a first set of film advance rollers coaxial with said belt-deflection rollers beyond said longitudinal edges of the respective belts, said film advance rollers being substantially the same diameter as said belt deflection rollers;

drive means for rotating said film advance rollers at a peripheral surface speed many times less than said predetermined speed of said belts;

and a first set of pressure rollers positioned immediately below said film advance rollers for engaging said film member between them to advance said film member between said belt-deflection rollers and said belts at substantially said peripheral surface speed of said film-advance rollers.

and a second abrading station having:

a second set of laterally spaced belts offset laterally from the belts of said first set and each having an abrasive outer face, an opposite inner face, and opposite longitudinal edges;

belt drive means for moving said second set of belts repeatedly along respective laterally spaced endless paths at said predetermined speed of said first set of belts;

a second set of coaxial belt deflection rollers positioned respectively along said paths above said abrasive faces of said second set of belts to deflect the corresponding belt downward to follow the peripheral contour of the respective deflection roller over a predetermined circumferential bottom portion thereof;

a second set of film-advance rollers coaxial with said second set of belt-deflection rollers beyond said longitudinal edges of the respective belts, said second set of film advance rollers being substantially the same diameter as said second set of belt deflection rollers;

drive means for rotating said second set of film-advance rollers at a peripheral surface speed many times less than said predetermined speed of said second set of belts;

and a second set of pressure rollers positioned immediately below said second set of film-advance rollers for engaging said film member between them to advance said film member between said second set of belt deflection rollers and said second set of belts at substantially said peripheral surface speed of said second set of film-advance rollers.

14. An apparatus according to claim **13** and further comprising means in each of said abrading stations for tensioning said belts therein to hold said belts up against said circumferential bottom portion of the respective belt-deflection rollers.

15. An apparatus according to claim **14** wherein:

said first set of film advance rollers advances said film member in the same general direction as the movement of said first sets of belts past said first set of belt-deflection rollers;

and said second set of film-advance rollers advances said film member in the same general direction as the movement of said second set of belts past said second set of belt-deflection rollers.

16. An apparatus according to claim **15** wherein said belt drive means in each of said abrading stations comprises a set of drive rollers located after said belt-deflection rollers along said paths of the corresponding belts and engaging the respective inner faces of said belts from below, each of said drive rollers having the top of its periphery at a higher level than the bottom of the periphery of the corresponding belt-deflection roller;

and each of said abrading stations further comprises:

a set of idler rollers located ahead of said belt-deflection rollers along said paths of said belts in said abrading station and engaging the respective inner faces of said belts from below, each of said idler rollers having the top of its periphery at a higher level than the bottom of the periphery of the corresponding belt-deflection roller.

17. An apparatus according to claim **16** wherein each of said abrading stations further comprises:

a set of tension rollers located below said pressure rollers and respectively engaging the inner faces of said belts from above;

and spring means acting on said tension rollers to pull down on said belts and thereby hold said belts up against the bottom of the periphery of the corresponding belt-deflection rollers.

18. An apparatus according to claim **17** wherein each of said abrading stations further comprises respective springs biasing said pressure rollers upward.

19. An apparatus according to claim **13** wherein each of said abrading stations further comprises respective springs biasing said pressure rollers upward.

20. A method of removing photographic images from a flexible film member having opposite major faces which comprises the steps of:

advancing said film member through an abrading station;

and in said abrading station momentarily clamping a predetermined short length of said film member across part of its width while abrading said short length of the film member across a neighboring different part of its width to scrape photographic images therefrom.

21. A method according to claim **20** wherein:

said clamping step is performed by engaging said opposite major faces of said film member between opposed rollers which advance said film member through said abrading station at a predetermined speed;

said abrading step is performed by an endless flexible abrasive belt scraping one of said major faces of said film member and moving through said abrading station at a much higher speed than said predetermined speed;

and further comprising the step of deflecting said film member and said abrasive belt to follow the peripheral contour of one of said rollers for part of its circumferential extent for scraping contact of said abrasive belt with said one major face of said film member throughout said part of said circumferential extent of said roller.

22. A method according to claim **21** wherein:

said film member is advanced through said abrading station in the same general direction as the movement of said belt through said abrading station.

23. A method of removing photographic images from a flexible film member having opposite major faces which comprises the steps of:

advancing said film member through a first abrading station;

in said first abrading station momentarily clamping successive short lengths of said film member across a plurality of laterally separated parts of its width while abrading said successive short lengths of the film member across different parts of its width next to said laterally separated parts;

advancing said film member from said first abrading station through a second abrading station;

and in said second abrading station momentarily clamping said successive short lengths of said film member across said different parts of its width while abrading said successive short lengths of the film member across said laterally separated parts.

* * * * *